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# THE CHIGNECTO SHIP RAILWAY,

—THE—

## SUBSTITUTE FOR THE BAIE VERTE CANAL.

Brief Review—Historical  
and Political.

Col. Morse, R. E., Chief of  
Royal Engineers.

One hundred years ago.

The Battleground between  
French and English.

A Highway for Defence in  
Time of War.

R. C. Minnette, P. L. S.

Francis Hall, C. E.

The first proposal for a canal to connect the waters of the Gulf of St. Lawrence with the Bay of Fundy was made during the French regime by the Abbé de la Loutre, the enterprising leader of the French colonists of Acadie.

In 1783 Colonel Robert Morse, Chief of the Royal Engineers, was ordered by Sir Guy Carleton, Commander-in-chief of His Britannic Majesty's forces in North America, to make a report on the "state of the defences, with observations leading to the further growth and "security of the colony of Nova Scotia," which then included New Brunswick and a part of the State of Maine. In this report Colonel Morse suggested "the idea of opening a water "communication between the Gulf of St. Lawrence and the Bay of Fundy," which, he said, "would be attended with good effects," and he spoke of "the many and great advantages "which would result to the country from such a communication."

In this respect all the engineers who have studied the project from that date have been in perfect accord with Colonel Morse, who, however, looked upon such a communication mostly from a military and naval point of view. He regarded the Canal as a means of naval defence, whereby war vessels could pass from sea to sea for the purpose of attack or defence without running the gauntlet of a hostile fleet on the Atlantic coast of Nova Scotia.

This isthmus of Chignecto is historic ground. Two-and-a-half centuries ago Fort Lawrence was the headquarters of Chevalier de la Vallière, the Seigneur of Chignecto and Governor of Acadie. From his day until the fall of Quebec the country within sight was almost continually the theatre of stirring action. The French regarded the possession of the Isthmus of Chignecto of strategic importance as a half-way station between Port Royal and Louisburg, Cape Breton, on the one hand, and Quebec on the other.

The English fought and struggled for its possession, as it afforded the French a base of operations from which the English settlements could be harassed. The tide of combat rolled around it intermittently for 150 years. It has been captured and recaptured in the French and Indian wars, and during the American revolution a small army of volunteers from the neighbouring republic besieged Fort Cumberland.

The heights of Fort Cumberland have frequently beheld fleets of war-ships flying the Lilies of France, and the White Cross of St. George. It ranks with Louisburg and old Port Royal in historic interest and importance, and was rightly considered one of the keys of Canada.

Should there be war between Great Britain and any European power there is no doubt that a highway for vessels of war, such as gun boats and torpedo boats, would be of the greatest possible advantage to Great Britain and Canada in the defence of the Maritime Provinces.

In 1822 the Government of New Brunswick instructed Mr. Robert C. Minnette, Provincial Land Surveyor, to make the first actual survey of a canal, which he accomplished in that year.

In 1825 Sir Howard Douglas, Governor of New Brunswick, employed Mr. Francis Hall,

HALIFAX ST. JOHN  
TORONTO HAMILTON  
QUEBEC WINNIPEG  
MONTREAL REGINA  
OTTAWA SASKATOON  
CALGARY EDMONTON  
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40545-

## THE CHIGNECTO SHIP RAILWAY.

Thomas Telford, C. E.,  
Founder of the Institution  
of Civil Engineers.

Civil Engineer, to report on the construction of a canal on the line of Mr. Minnette's survey.

In 1826 Mr. Thomas Telford, the most eminent English engineer of the day, was consulted as to the feasibility of Mr. Hall's plans. He reported that "if this canal were completed, ready access would thereby be opened, not only with Quebec and Montreal, but also with the upper lakes to a boundless extent."

Capt. Crawley, R. E.

In 1843, Capt. H. O. Crawley, of the Royal Engineers, was employed at the joint expense of Canada, New Brunswick, and Prince Edward Island to report on previous schemes. He said: "It is unnecessary for me to dwell upon the importance of an undertaking which seems to be generally admitted."

Brief Review of Railway.

After this date public attention was directed to Railways and it was proposed to utilize the Steamship Lines now established on either side of the Isthmus by transshipping freight over a Line of Railway to be built between the Bend of Petitcodiac on the Bay of Fundy, and Shediac on the Gulf of St. Lawrence.

First Railway over the  
Isthmus.

In 1853, a Company was formed and a contract made with Messrs. Peto, Brassey, Betts and Jackson, and work commenced on this Line of Railway from Moncton to Point du Chene, a distance of 18 miles. It was, however, taken out of the hands of that firm in 1856 and completed by the Government of New Brunswick in 1858. This was the first line constructed by the Government of that Province. Cargoes from the Gulf ports were transhipped at Point du Chene, carried over the Isthmus and again put into steamers on the Bay of Fundy. In 1860, this line was extended to St. John, New Brunswick, a total distance of 108 miles, and freight from the Gulf Ports and Prince Edward Island was then transhipped from steamers to the railway and from the railway to the steamship lines plying between St. John, N. B., and Portland and Boston.

Moncton to Shediac.

St. John to Shediac.

Pictou to Truro.

A line from Pictou to Truro, a distance of 55 miles, was afterwards completed across another part of the Isthmus by the Government of Nova Scotia.

Other Lines between Gulf  
and Bay.

Subsequently a Line of Railway from Sackville to Cape Tormentine, and branches from the Intercolonial Railway to Buctouche, Richibucto, Chatham, Caraquet, Dalhousie, N. B., have all been completed, showing the great importance attached to the trade flowing from the Gulf of St. Lawrence towards St. John and the United States.

Extract from the St. John  
Telegraph.

"The business done on these lines affords evidence of the large volume of traffic seeking transit between the Gulf and Bay, or between the Gulf and the Eastern States of the Republic."

"Where there is so large a railway traffic it needs no argument to show that there must be an enormous water borne traffic when once the Short Cut across the Isthmus of Chignecto is possible."

Bulky articles not carried  
by rail with economy.

Notwithstanding these railway facilities there are many bulky articles of commerce which cannot, with economy and convenience, be carried any great distance by rail, and when there is a necessity and expense of transshipment and rehandling, the railway carriage becomes sometimes too expensive to leave any profit. Such is the case with lumber, coal, gypsum, plaster, building stone, potatoes, deals, fish, &c., &c.

In 1869 a Company was incorporated by the Legislature of Nova Scotia to build the canal, as a private work, and the interest in it was accordingly revived.

Canal History resumed.

In 1869 the late John Page, C. E., Chief Engineer Public Works, was called upon to report upon all previous surveys of the Baie Verte Canal, which at this date had again become a live question, and further surveys were ordered by the Dominion Government. In 1871 a

John Page, C. E.



G. F. Baillargé, C. E.

most thorough survey was made of the whole Isthmus by Mr. G. F. Baillargé, Assistant Chief Engineer of Public Works.

Sir Casimir Gzowski.

In 1872 Sir Casimir Gzowski and the late Mr. Samuel Keefer, C. E., surveyed and recommended a line of Canal approximately on the route of the present Ship Railway.

Samuel Keefer, C. E., observed that in the comparatively isolated condition of the Provinces before Confederation the necessity for this short line of communication was not felt; but now that they form one united Dominion, bound together by ties, political and commercial, the trade growing up between them must tend year by year to give greater importance to the proposed shorter and safer line of navigation.

Cost of Canal.

The estimated cost of this line of canal by these engineers was \$5,317,000, but Mr. Page, on examination of the estimate, alleged that there had been undervaluations and omissions, and he added to it 25 per cent. for undervalue placed on works, \$1,329,250, and for omissions \$450,000, making the probable actual cost of work, according to Mr. Page, \$7,100,000.

Estimate revised by Mr. John Page.

Mr. Page declares a Canal unusually difficult of construction.

Mr. Page declared "that the construction of a navigable channel between the Bay of Fundy and the Gulf of St. Lawrence, on any line that can be selected, will be an undertaking attended with unusual difficulty, not only from the nature of the work to be done, but from the great difference in the elevation of the respective tides."

Tides of the Bay of Fundy.

The range of the tides in the Bay of Fundy has always been exaggerated in school books and gazetteers. The most careful observations taken by Mr. Baillargé, C. E., in 1870, resulted in establishing the range of tides to be 38 feet at Neap and 48 feet at Spring tides. The greatest tide ever known occurred on the 5th October, 1869, at new moon. The range was then fifty-seven feet, six inches. It is well known as the Saxby tide, so called from a prediction made nearly a year before it happened, by Lieut. S. M. Saxby, R. N., which appeared in the London *Times* in December, 1868. The following reasons for the prediction were given in his own words: "At 7 a. m., October 5th, the moon will be at that part of her orbit nearest the earth. Her attraction will therefore be at the maximum force. At noon of same day the moon will be on the earth's equator, which never occurs without marked atmospheric disturbance, and at 2 p. m. same day lines drawn from the earth's centre would cut the moon and sun in the same arc of right ascension. The moon's attraction and the sun's attraction will therefore be in the same direction. In other words the new moon will be on the earth's equator and nothing more threatening can occur without miracle." This prediction was verified by very high tides and terrible storm on the Bay of Fundy.

Saxby's Prediction.

Tides of Baie Verte.

The extreme range of tides in Baie Verte was observed to be 10 feet 8 inches; the ordinary range being only 5 feet 7 inches. Thus while the fluctuations above and below the mean sea level were only 2 feet 9 inches at Baie Verte, they were at the same time 19 feet above and below mean sea level on the Bay of Fundy at Neap tides, and 24 feet at Spring tides.

Royal Commission of 1871.

A Royal Commission composed of the most representative commercial men of Canada, selected from the different provinces, was appointed by the Government in 1871 to investigate the whole canal system of Canada, with the late Sir Hugh Allan as Chairman. The Baie Verte Canal after full enquiry and examination, was placed by them in the first rank of all the canals of the Dominion. The following is extracted from the report of the Canal Commission: "The growth of Intercolonial trade depends on cheap transit, since the merchandise passing between the Maritime Provinces and Ontario must be of a bulky character, requiring large vessels and rapid dispatch to be really profitable. When a propellor can go direct with a

Sir Hugh Allan, Chairman.

Traffic expectations.

## Cargoes.

"cargo of coal, or other produce of the Eastern Provinces, to Kingston and Toronto, and there  
 "get a return freight of flour, barley, and other Western produce, Intercolonial trade will  
 "have entered on a new era.

"When Nova Scotia coal of the best description can be supplied abundantly and cheaply  
 "to western ports, a great impulse will necessarily be given to the transfer of the trade of the  
 "St. Lawrence and Lakes to screw steamers, a transfer already taking place, as we have  
 "previously shown.

## Reduction of Coal Freights.

"With the canals enlarged, coal freights would be reduced to the minimum point—a lake  
 "propellor would always bring back from the lower ports a cargo of coal, rather than come  
 "empty—just as the English timber ships have been accustomed to bring the same article  
 "instead of ballast.

"Inseparably connected with the growth of Intercolonial trade is the construction of the  
 "Baie Verte Canal across the Isthmus, connecting the Provinces of Nova Scotia and New  
 "Brunswick. The advantages that must accrue, not merely to the Dominion as a whole, but  
 "to the commerce of the Maritime Provinces, are so clearly pointed out by the Boards of  
 "Trade of all the leading cities of Canada, and by men interested in the development of our  
 "commercial interests, not simply the merchants of St. John and other places in the locality  
 "of the proposed Canal, but merchants of Hamilton, Toronto, Ottawa, Montreal and Quebec,  
 "that it is superfluous for the Commissioners to do more than briefly refer to a few salient  
 "features of the scheme.

## Saving of Time.

"A steamer laden with flour for St. John, N. B., now goes down the Gulf as far as  
 "Shediac, where the cargo is transported by rail to its destination. The total distance by  
 "water from Shediac through the Gut of Canso and around the coast of Nova Scotia to the  
 "Bay of Fundy as far as the commercial capital of New Brunswick is about 600 miles, and  
 "the consequence is that there is little or no direct communication between the Bay of Fundy  
 "ports and those of the River St. Lawrence. By a Canal through the Isthmus the distance  
 "from Shediac to St. John will not be much more than one hundred miles."

Lord Dufferin's Speech  
from the Throne.

Accordingly the Government of the day decided to proceed with the construction of the  
 canal. His Excellency Lord Dufferin, at the opening of the session of 1873, in his speech  
 from the throne, used the following language:

## His language.

"I am glad to inform you that plans and specifications for the enlargement of the Wel-  
 "land, and the construction of the Baie Verte Canal, have been completed, and that the works  
 "can now be put under contract. The surveys for the St. Lawrence Canals will, I am assured,  
 "be finished in time to commence the works at the beginning of next year. This will insure  
 "the completion of all these great works at the same period."

Government Pledged to  
Canal.

In accordance with the promise thus given, one million dollars was placed in the esti-  
 mates for the construction of the Baie Verte Canal, which, according to the late Mr. Page's  
 estimate of the line surveyed by Messrs. Gzowski and Keefer, was to cost \$7,100,000.

Royal Commission, Hon.  
John Young, Chairman.

In 1875, under a change of Government, another commission was appointed, with the  
 late Hon. John Young as chairman. The report made by this Commission was unfavorable.  
 Indeed, it is said the Commission was purposely appointed to defeat the project and save the  
 new Government the necessity of making the outlay already pledged by Parliament.

## Prejudiced Report.

The Hon. Joseph Lawrence, one of the Commissioners, protested against the verdict of  
 the majority, and ably defended the commercial prospects of the canal in a separate report.

It was afterwards discovered that an error had been made in their computation of the

## Mistake in Distance.

distance to be saved by the Short Cut. The Commissioners had represented the distance saved from Montreal to St. John as only 225 miles, whereas it is actually 500 miles, making an error in their calculations of 275 miles. Their opinion was, that the small distance to be saved would not warrant the expenditure. The prejudice produced in some quarters by the misrepresentation of distance (and hence the erroneous conclusions of the report) endures to this day. The following admissions were however made:

"The evidence taken, and the observations which the Commissioners have had the opportunity of making, have impressed them deeply with the vast resources of New Brunswick, Nova Scotia and Prince Edward Island, and the large increase which may be reasonably looked for in their trade and commerce."

## Fortunate result for the Dominion.

It was, however, most fortunate for the Dominion that the verdict of this Commission, incorrect as it was, delayed for a while the public expectation. It gave time for a *new idea* to be developed which was happily destined to prevent the country from falling into a most irretrievable error of judgment and from an expenditure counted by millions of dollars,—a *better mode of communication between the two seas was possible.*

## A Ship Railway.

In 1875 the author of this paper submitted his opinion to the public through the Press that a SHIP RAILWAY would not only fulfil all the requirements, but in many respects would be preferable to a canal; that there was no engineering difficulty either in the construction or operation of such a line; and that vessels in full cargo could be transported over the Isthmus in perfect safety and at small expense. That the transport would take less time, and the maintenance, repairs and operating would be no greater than by canal. This bold suggestion arrested all further discussions of a canal, and for six years there was no further move made tending to solve the problem of the Isthmian Transit. The Dominion Government had entered upon a policy of fostering its own manufactures and relying upon its own productions for its prosperity. The result soon showed itself in a marked increase in the raising of coal and lumber, which was followed by a corresponding increase in the coasting trade and commercial marine of the Maritime Provinces.

## The National Policy.

## Proposal to Government.

At length, in 1881, the author carried out, at his own expense, a survey and location for a Ship Railway, and having found a good line, submitted a proposal to the Hon. Sir Charles Tupper, Minister of Railways and Canals, offering to form a company to carry out the work, provided the Government would subsidize the work, for about one-third the cost of a canal.

## Annual Subsidy.

The proposed subsidy took the form of an annual contribution by the Government to the Company of \$150,000 per annum for twenty-five years, which, if capitalized at four per cent., would be equal to the sum of \$2,343,312.

## Great saving to the country.

The proposal, therefore, if adopted, would save to the country the cost of the Canal, to which it was pledged, as before stated, estimated at \$7,100,000, less the sum of \$2,343,312, the capitalized value of the subsidy, or a saving of no less than \$4,756,688.

## Report of Mr. Schrieber, C. E.

Hon. Sir Charles Tupper, Minister of Railways and Canals, referred the whole question to the Chief Engineer of his Department, and Mr. Collingwood Schrieber reported as follows:

## Project practicable.

1. "That the project is quite practicable of execution."

## Ship Railway a good substitute for the Canal.

2. "That the Ship Railway as proposed would be a good substitute for the Canal originally contemplated."

## Great advantage in respect of cost.

3. "That the advantage in respect of cost as compared with that of a Canal would be greatly in favour of the Ship Railway, the cost of a half tide canal being calculated by the Government Engineers at from \$5,650,000 to \$8,217,849; whereas the subsidy asked for by

## THE CHIGNECTO SHIP RAILWAY,

Report of the Commission  
of 1871, quoted by Mr.  
Schrieber.

Distance saved 500 miles.

Freights would be reduced  
25 per cent.

The Baie Verte Canal as  
much a part of the Cana-  
dian Canal as the Sault  
St. Marie.

Canadian in design and  
National in results.

Forceful evidence.

Words of twenty years ago.

Increased trade since 1871.

Proposal accepted.

Company formed.

Board of Trade opinions.

Ship Railway will develop  
resources.

"the Company, namely, \$150,000 for 25 years if capitalized at 4 per cent. would be equal to the sum of \$2,343,312 only."

"The Commissioners in their Report on page 51 state: "The distance from Shediac to St. John by the present route, via the Gut of Canso, to be 600 miles. This distance would be reduced by the construction of the Baie Verte Canal to about 100 miles, and freights would, in their opinion, be diminished by 25 per cent. greatly benefitting the coal trade and fisheries, and increasing the volume of general business."

They state further (page 53): "This canal cannot be considered apart from the canals of the St. Lawrence Canal as a Canadian canal, as Sault St. Marie is the natural commencement of the improvements of the inland navigation of the Dominion, so the work through the Isthmus of Chignecto is the inevitable conclusion necessary to give unity and completeness to the whole system. It is Canadian in design and must prove national in its results."

On page 79 the Commissioners say: "The evidence submitted points out with remarkable force and unanimity the necessity of opening a Highway for commerce between the Gulf of St. Lawrence and the head waters of the Bay of Fundy through the Isthmus of Chignecto dividing them."

The above statements are now twenty years old and the tonnage of the ports adjacent to the Isthmian Transit has more than doubled itself since those words were written.

The Chief Engineer further said, that "Assuming that the importance of a Ship Highway over the Isthmus was, at the time of the Commissioners Report so great as therein stated, it must be much greater now considering the large increase since that date in the trade of the country affected by the proposed work."

The proposal of the author was accepted by the Government, approved by Parliament, and a Company incorporated to carry out the undertaking. The provisional Directors were: Mr. Thomas C. Keefer, C. M. G., the founder of the Canadian Society of Engineers; Mr. Edwin Clark, the eminent engineer and inventor of the Hydraulic Ship Lift; Mr. C. R. Coker, Lloyds Surveyor of Shipping; Mr. R. G. Lunt, the well-known Steamboat Manager; and the author.

The Board of Trade of St. John, New Brunswick, passed the following resolutions on the 20th October, 1883:

"Whereas, Means of communication between the waters of the Bay of Fundy and the Gulf of St. Lawrence, whereby products of the several Provinces bordering thereon may be interchanged without encountering the dangerous navigation of the Atlantic Coast of Nova Scotia, whereby steamers and sailing vessels, adapted as well for inland as for ocean navigation, may be safely conveyed across the Isthmus of Chignecto without the cost and delay of transshipment or breaking bulk, and whereby the sailing distance between this port and all ports north and west of said Isthmus may be reduced about 600 miles, would materially increase the volume of trade and benefit the shipping interests of this port and other ports in the Bay of Fundy, and Gulf of St. Lawrence; and

"Whereas, By means of a Ship Railway across the Isthmus, the objects aforesaid may be accomplished, and thus stimulate the development of the agricultural, mining, lumbering and fishing resources of the district contiguous to the aforesaid parts; and

"Whereas, A company has been formed for the construction and operation of a Ship Railway, with commodious Docks and Hydraulic Lifts for raising and transporting over its line laden vessels of 1,000 tons register; therefore



## Facilitate trade.

"Resolved, That this Board is of opinion that the undertaking of said company would greatly facilitate trade and commerce between the Eastern and Western Provinces; and further

## The Board of Trade approves Ship Railway.

"Resolved, That this Board cordially approves the project for building the said Ship Railway, believing that this is a movement which will commend itself to all classes, and prove to be of great convenience and benefit to our trade and commerce generally."

## Contract made for Ship Railway.

In March, 1886, a formal contract was entered into by the Company with the Government which made a change in the annual payments of the subsidy, but reduced the time over which it extended from 25 years to 20 years. The company was not to call upon the Government for any portion of the subsidy except what might be required to make up the net earnings of 7 per cent. on the authorized capital of \$5,500,000, and the company agreed to pay over to the Government one-half the surplus profit beyond the 7 per cent. until the whole of the subsidy which may then have been paid to the Company shall have been repaid to the Government.

## Mr. Meiggs offers to carry out the Ship Railway.

After various unsuccessful attempts by the author to get parties to undertake this novel and difficult work, and find the money, at last, in the early part of the year 1888, Mr. John G. Meiggs, the eminent contractor of South American fame, offered through the author to form a company in London to carry out the undertaking, provided an extension of time could be made to the contract already entered into with the Government.

Application was accordingly made and the extension of time granted by the Dominion Government and Parliament in the spring of 1888.

## Plans approved.

The plans were prepared and submitted to the Chief Engineers of the Department of Railways and Canals, and formal approval given by the Governor General in Council, in May, 1888.

## Line located.

The line of railway and docks were then finally located under the instructions of the author by Mr. J. S. Armstrong, Mem. Can. Soc. C. E., and tenders invited for the grading, masonry, and the various works.

## Company organized.

The Company was re-organized in London, the preliminary stock subscribed, and Directors appointed.

## The Board of Directors.

The Board consists of Mr. Thomas Wood, President; Col. Paget Mosley, Vice-President; Mr. A. D. Provand, M. P., Mr. W. H. Campbell, Mr. A. R. Robertson, and Mr. Arthur Serena, Directors.

## The Engineers.

Sir John Fowler, Sir B. Baker, and H. G. C. Ketchum were appointed Engineers.

## The Contract.

A contract was then entered into between the Company and Messrs. John G. Meiggs & Son for the execution of the work, and subsequently £650,000 of the capital was raised in London by subscription; £300,000 being in preferred shares and £350,000 in First Mortgage Bonds.

## Work begun on Ship Railway.

Under this contract, work was commenced by the Company in October, 1888. Messrs. Meiggs & Son contracted with Messrs. Dawson, Symmes & Usher, of Niagara Falls, for the earthwork and masonry, for the line of railway and docks, the dredging of the entrance channels, and the platelaying and ballasting; also for the erection of the moles at Tidnish. With Messrs. Easton & Anderson for the supply of the hydraulic lift machinery, its erection and working. With Messrs. Rhodes, Curry & Co., of Amherst, for buildings containing the pumping machinery. They also supplied the heavy pine sleepers for account of Messrs. Dawson & Co. Messrs. Cammell & Co., of Sheffield, supplied the steel rails, which are 110 lbs. to the yard of toughened steel. Messrs. Handyside & Co., of Derby, supplied the ship cradles, which are made entirely of steel. Messrs. James Harris & Co., of

## The sub-contracts for the various works.



## THE CHIGNECTO SHIP RAILWAY,

St. John, contracted for the cradle wheels, and the Canadian Locomotive and Engine Co., of Kingston, are building the heavy tank locomotives.

## The engineering staff.

The engineering staff, under Messrs. Fowler, Baker & Ketchum, consisted of Mr. F. F. S. Kelsey, resident engineer; Mr. J. S. Armstrong, principal assistant; Mr. M. Fitzmaurice, assistant engineer; Mr. S. J. Symonds, inspector, and others, on behalf of the Company: Mr. George Buchanan, engineer, and Mr. Arthur W. Bateson, agent, for the Chief Contractors: Mr. J. B. Denison, and Mr. G. F. May, engineers for the Hydraulic Works: and Mr. P. J. O'Rourke, engineer for the Sub-Contractors.

## The Land.

The land required for the line of railway and docks was presented as a gift by the Municipality of the County of Cumberland, Nova Scotia.

## The stoppage.

The works were prosecuted vigorously from the date of commencement to the end of July, 1891, when they were unfortunately stopped because of the impossibility of floating the remaining bonds which the company had in hand (viz., £350,000) in the present critical state of the money market.

## Cost to date.

Up to the time of suspension, the engineer's certificates for work done and materials furnished by the contractor, amounted to £670,894 5s., paid in cash, bonds and shares, and the engineering and administration expenses of the Company amounted to about £30,000 in addition.

## Estimate to finish works.

From a careful estimate made of the cost to finish the works, to equip with rolling stock, to provide interest on capital, to finance the remaining debentures, and to provide for further engineering and administrative expenses, it is calculated that \$1,500,000 will fully cover all this expense.

## Progress made.

The whole works may be said to be three-fourths done, and it would take but one summer season's work to entirely finish the Ship Railway and Docks fit for opening to the public.

The principal excavation yet to be done is that for the entrance channels at each end of the line, which have been commenced and are considerably advanced, but cannot be entirely finished until the hydraulic machinery for lifting the vessels is erected.

## Present state of works.

All the hydraulic machinery has been manufactured and delivered. All the rails, sleepers, and permanent way materials have been delivered. The whole of the line of railway has been graded with the exception of about a mile of broken work. Twelve miles of track have been laid, and the greater part of the bottom has been ballasted with broken stone. The costly work remaining to be done is the masonry and gate of the basin at the Bay of Fundy end of the line, and the masonry of the two lifting docks. The buildings containing the hydraulic pumping machinery have been nearly finished and the machinery in them erected.

## Rolling Stock nearly complete.

The ships' cradles, manufactured of steel, and the locomotives, are nearly ready for delivery. The moles protecting the Basin on Northumberland Straits, have been entirely finished and accepted. The firm of Easton & Anderson, who undertook the supply and erection of hydraulic machinery, as well as the traversers for shunting vessels, has agreed for a specified sum to work and maintain this machinery in good order for one year from the date of the opening of the line, the Company being required to provide the coal.

## Size of vessel.

The size of vessel provided for is 1,000 tons register; the maximum length would be 235 feet, breadth 56 feet, draught 15 feet, with a displacement of 2,000 tons. Accommodation space for six vessels of this size has been provided in the Basins at each terminus of the Ship Railway. This is the only instance in the history of Canada where a wet dock and harbor basins and dredged entrance channels have been provided at the expense of a private com-

## Space for six vessels in the Basins.

pany. The cost to the Company of these entrance channels, dock gates, sea walls, basins and moles will be, when finished, about one million dollars, exclusive of the hydraulic lifts.

The following extract from Sir Benjamin Baker's description of the Chignecto Ship Railway, as published in the *Nineteenth Century Magazine* for March, 1891, cannot be improved upon, and it is, therefore, embodied in this paper:

#### Hydraulic Lifts.

"The hydraulic lifts, when raised, form a part of the main railway as regards line and level; and when lowered with the cradle the depth of water over the keel-blocks on the latter is that requisite for floating the vessel on the blocks. Walls of massive masonry, 56 feet in height from foundation to quay-level, surround the hydraulic lifts. The latter each consist of twenty hydraulic rams of 25 inches diameter and 40 feet stroke, enclosed in 26-inch diameter cylinders provided with stuffing-boxes at the upper ends, and with inlet pipes for the admission of water at a test pressure of 1,300 lbs. per square inch. On the top of each ram is a cross-head, from which hang two lifting links, connected at the lower ends with the gridiron upon which the ship and cradle rest when being lifted. The gridiron, 235 feet in length and 60 feet in width, consists of a very stiff combination of longitudinal and cross girders made of steel and firmly riveted together. When lifted to the level of the railway the ends of the cross girders are supported on the quay walls by iron chock-blocks worked by hydraulic power, so that the gridiron then in effect constitutes a solid part, as before said, of the main line. Hydraulic pumping machinery is provided of sufficient power to raise a vessel weighing 2,000 tons, or, including the gridiron and cradle, a total weight of 3,500 tons, the required height of forty feet in twenty minutes. Hydraulic power is also provided for capstans and winches for manœuvring the vessels, and air-compressors are furnished for clearing the pipes and cylinders quickly of water—a precaution specially necessary in a northern climate. Special arrangements are made in the engine-house to enable the engineman to ensure the equable and simultaneous motion of the ten lifting rams on each side of the deck, so that no straining of the gridiron may occur.

#### The Line itself.

"A double line of railway of the ordinary 4 feet 8½ inches gauge is laid along the top of the gridiron, upon which the ship-cradles are run. These cradles are provided in sectional lengths of 75 feet and 57 feet to accommodate vessels of ranging dimensions. For a ship of 2,000 tons dead weight three sections would be used. The cradles, like the gridirons, are formed of a rigid combination of steel girders carrying keel-blocks and sliding bilge-blocks of the usual lifting-dock type. Each 75 feet section of cradle is supported on sixty-four solid wheels of three feet diameter, having double bearings and four spiral springs of exceptional strength. Unlike ordinary ship cradles, therefore, a considerable amount of elasticity is provided in the present case. It need hardly be remarked that many interesting problems have had to be worked out in connection with these cradles which it is impossible to refer to here.

#### The Cradles.

#### Mode of operation.

"The order of procedure in raising a vessel and transporting it seventeen miles across this isthmus to the sea on the other side would be as follows: A vessel coming up the Bay of Fundy on the flood tide would pass through the gate entrance into the dock and wait its turn to be lifted. If the vessel were a 'trader' on this route, its dimensions would have been recorded, and the keel and bilge blocks would have been got ready on the cradle, telegraphic notice having been received of the probable arrival of the ship. If she were a 'tramp,' a ship's carpenter would have to go on board and take some leading measurements for the arrangement of the blocking on the cradle. The blocking being arranged, the cradle and gridiron would be lowered by the hydraulic rams into the water and the vessel would be hauled over it by capstans and winches in the usual way. The gridiron would then be slowly raised until the vessel rested on the keel-blocks throughout her whole length, after which the sliding bilge-blocks would be pulled tight against the ship's bilge by chains attached to the blocks and carried up to the quay on either side. Lifting would then proceed until

the rails on the gridiron attained the same level as those on the main line of railway, when, as before explained, the ends of the girders would be securely blocked. The ship and cradle would then be hauled off the gridiron on to the railway by powerful hydraulic winches, and after a final adjustment of the blocking, the vessel would be taken in hand by two of the giant locomotives already referred to, and be transported across the isthmus on to the hydraulic lift on the other side, where the converse operations would be effected to enable the vessel to resume her ocean voyage.

The Blocking of the Vessel.

"Various plans have been proposed from time to time for the quick and efficient blocking of the curved surface of a ship's hull to the flat top of the cradle. Hinged bilge-blocks, hydraulic rams, elastic bags filled with air or water, and many other contrivances have been suggested, but the present universal practice in docking or in launching a ship is to use simple wooden keel and bilge blocks. In docking a vessel, nearly the whole of the weight comes on the keel blocks, and the bilge-blocks are few in number and extend only for about the middle third of the ship's length. In launching a vessel, the weight is transferred from the keel-blocks on to the launching-ways on each side of the same by means of a couple of narrow cradles or bilge-logs, of hard wood packed up to the hull of the vessel by soft wood filling. These cradles carry the ships down the too often imperfectly bedded inclined launching-ways at a speed of some twelve miles an hour. As the vessel is leaving the launching-ways her stern is waterborne whilst the bow is pressing hard on the shore, but yet it is the rarest thing for any mishap to occur to a vessel even under this singularly rough treatment. The best way of blocking a ship on a railway cradle will be quickly determined after a few weeks' experience, but at Chignecto the method adopted in the first instance will certainly be the well-tried one of timber keel and bilge blocks.

The heavy permanent way.

"Nothing calls for special notice as regards the line of railway. It is, as before stated, a double line of ordinary gauge, but the space between the two lines is five feet wider than usual. Very strong steel rails, weighing 110 lbs. per yard, and exceptionally large sleepers, spaced very closely together, give the required support on the ballast to the heavily laden ship cradle. Near the Amherst end a long and deep moss or bog had to be crossed, and, as the floating system adopted by Stephenson for the original Manchester and Liverpool Railway across Chat Moss would obviously be inappropriate for the heavy loads of a ship railway, there was no alternate but to form a solid rock embankment across the bog, and this has now been successfully completed. On other parts of the line there is a heavy rock cutting and a river bridge, but beyond these matters there are no works of importance on the line."

Mr. Corthell's Report.

During the construction of the railway Mr. E. L. Corthell, C. E., a distinguished American engineer of Chicago, paid a visit to the Ship Railway for the purpose of ascertaining its merits and to examine into the facilities which Canada could provide for the carrying trade of the West, and, in a letter published in the *Toronto Globe*, he reports as follows respecting the Ship Railway:

No question as to commercial success.

"The entire work, in all its general features, as well as in its details, has been very carefully studied out, and the material has been properly arranged and well put together for all of the mechanical work. I also made careful inquiries and obtained reliable data in regard to the commercial features of this project. There is no question, in my opinion, about the entire success of this work from a commercial and financial point of view. There is a large commerce now existing which will certainly seek this shorter and more economical route. The opening of a line of communication for ships across the isthmus will develop new commerce, and I do not hesitate to predict, in view of all that I heard and saw in regard to the commercial features, that within three years from the opening of the line for business it will have all it can handle. A Company allied to the Ship Railway Company has been formed



"in England for the purpose of building for this new route several side-wheel steamboats adapted to the trade between Prince Edward Island and the New Brunswick and Maine coast, which, I have no doubt, will have all the business they can attend to."

Mr. Corthell again speaks.

Mr. Corthell also in a paper read before this Society in February, 1890, referring to the Chignecto Ship Railway, repeated that, "There is no doubt in his mind of the entire success in the construction, operation and economy of this railway. There is nothing novel in the method only in the combination of methods. Vessels are at present raised out of the water continually, whether loaded or unloaded, on hydraulic lifts either by Marine Railways or by Floating Docks."

Necessity for larger cars on railways.

"The increasing size of rolling stock, both motive power and freight cars, on ordinary railroads, has proven the great advantage in carrying greater and greater loads at one time. A few years ago 10-ton cars were the rule in this country. Now 30 tons are becoming more and more numerous. Cars for still larger loads for special purposes are becoming more and more common, and the locomotives have increased in weight and power from 30 and 40 tons to 90 and 100 tons, and the cost of transportation has been reduced from 2½ cents to ½ cent per ton mile."

A Ship Railway the logical result.

"A Ship Railway is the logical result of the continual improvements in railroad methods from the time of the first railroad to the present. If it is possible to raise vessels and transport them over-land with safety and economy, why should they be compelled to make great detours costing time and money?"

"If the immense business between the St. Lawrence and the coast of New Brunswick and New England can save 500 to 700 miles by operating a railway 17 miles long across the Chignecto Isthmus, why should it continue to take this long and dangerous voyage around Nova Scotia?"

Present tonnage adjacent to the Ship Railway.

According to the official returns from the Report on Trade and Navigation for the year ending 30th June, 1890, the tonnage arriving and departing at the various ports contiguous to the Ship Railway was as follows:—

	<i>Vessels.</i>	<i>Tons.</i>
Gulf of St. Lawrence,	28,787	6,422,976
Prince Edward Island,	8,793	1,362,861
Bay of Fundy,	33,345	3,855,932
Grand Total,	70,925	11,641,769

The rate of increase for several years has been half a million tons per annum according to official Blue Books.

Ports not within the sphere of traffic.

This tonnage does not include any port west of Quebec or on the Atlantic coast of the Peninsula of Nova Scotia. Although the Ports of Portland and Boston might come within the sphere of traffic, they, like Montreal, Toronto, and ports west of Quebec, are omitted in the above table.

Expected tonnage.

The Company's estimate of traffic is based on only seven per cent. of the tonnage of the Gulf and Bay, or 800,000 tons. Should the Ship Railway draw this moderate proportion of the tonnage it is estimated that there would be a revenue nearly sufficient to pay a dividend of seven per cent. on the capital of the Company without calling on the Government for any portion of the guarantee, as appears by the following figures:—

## THE CHIGNECTO SHIP RAILWAY.

## Estimates of Traffic.

800,000 tons freight at an average of 50 cents per ton,	\$400,000 00
800,000 tons vessels' hulls at an average of 12½ cents per ton,	100,000 00
Estimated Receipts,	\$500,000 00
Working expenses and administration as per estimate of Sir B. Baker, being 30 per cent. of the receipts,	150,000 00
Net Revenue,	<u>\$350,000 00</u>

## Another estimate.

Setting apart the subsidy to provide interest on the bonds for 20 years, a traffic of only 320,000 tons at the above rates, would provide 7 per cent. on the preferred share capital, and 7 per cent. on the ordinary share capital, thus:

320,000 tons at the average rate of 50 cents per ton,	\$160,000 00
320,000 tons vessels' hulls at the average rate of 12½ cents per ton,	40,000 00
Receipts,	\$200,000 00
Working expenses, 30 per cent.,	60,000 00
Net Revenue,	<u>\$140,000 00</u>
7 per cent. on \$1,500,000, preferred shares,	\$105,000 00
7 per cent. on \$500,000, ordinary shares,	35,000 00
Total dividend,	<u>\$140,000 00</u>

## Working Expenses.

The working expenses of the Ship Railway, as compared with a railway of the ordinary type, should be very small indeed. The line is perfectly straight. One-half of it is absolutely level. The other half has gradients not exceeding 10 feet to the mile. The works are solidly built, the rails heavy; the sleepers of unusual size; the ballast, broken rock; it is believed the cost of maintenance of way will be reduced to a minimum. It may be considered a freight line, without the usual terminal expenses. The freight, that is the vessel with its cargo, loads and unloads itself automatically on and off the railway. The speed will be slow, not exceeding ten miles an hour. Fuel is cheap in the coal producing county of Cumberland, Nova Scotia. Besides the cost of lifting vessels to the level of the railway and depositing them afterwards into the sea, which is very small, the principal cost will be the locomotive power, which on ordinary railways bears the proportion of about 17½ per cent. to the gross earnings. It is believed therefore that the estimate of 30 per cent. for working expenses is full. The estimate of working expenses was based on the usual cost of maintenance and repairs on a double track railway for the whole year. Without any especial effort to economize, the Ship Railway might be worked for \$50,000 per annum, which would, of course, permit of the same profits with very much less tonnage. A regular daily line of steamers between St. John and Charlottetown over the line of Ship Railway would contribute largely to the business expected. The Chignecto Steamship Company has been formed in London, with a capital of £60,000, for this purpose; the untoward financial crisis so far has prevented this object from being consummated, but it is steadily kept in view.

## Fuel cheap.

## A line of steamers in connexion with Ship Railway.

## The tolls.

## Average rate on cargo.

The tolls to be charged on the Ship Railway must be sanctioned by the Governor General in Council before being levied and collected by the Company.

The estimated average rate of fifty cents per ton is therefore only suggested as the probable rate that the Government would be inclined to sanction for the freight carried, for it is,

## Saving on freight.

in fact, very similar to the charges prevalent on the Welland Canal, which have been levied by the Government itself. The proposed rates, which, although they amount in the average to half a dollar a ton, will scarcely be felt when levied on the bushel or barrel by the shipper, who is accustomed to the high freights levied by the foreign steam lines running through the Straits of Canso to Boston. At this rate one dollar will be saved on all freight going round to St. John by water, and more than that by rail. The freight from St. John to Baie Verte being \$2.50 per ton, while that to the head of the Bay of Fundy is one dollar per ton, there is a difference of \$1.50 per ton, and deducting 50 cents per ton for the transport across the Isthmus, there is one dollar saved in the freight, not to count the saving of time and insurance. The saving, over and above railway carriage, would be \$2 a ton from North Shore ports to St. John, N. B.

## Charges on hulls.

The charges on freight cargoes would be at the same rate, no matter by what description of vessel carried, but the rates on the hull would probably be required to be on a sliding scale according to the size of the vessel, the highest rate being on the smallest vessel, because a small-sized vessel would occupy the railway as long as a large sized one, and the revenue otherwise obtainable from small vessels would not bring a profit to the Company. The estimated proposed average rate of 12½ cents per ton would be a fair rate to charge on hulls as compared with that on Canals where the cost of towage is considered; the latter being done on the Ship Railway by locomotives and on the Canals by steam tug-boats.

## Time saved.

Respecting the time to be saved and the safety of vessels on the Ship Railway, no less than twenty-four prominent firms of shipowners in London and Liverpool, having experience of the coast of Nova Scotia, have certified that a saving of ten days would generally be made by sailing vessels clearing from ports on the Gulf, and making for St. John, Portland and Boston, by using the Ship Railway, and so avoiding the weathering of Cape North and Cape Canso, as by present route. They have certified also that loaded vessels would not be injured on the Railway, if supported on a cradle such as is used on all marine slips.

## Safety of vessels.

The most prominent naval architects of the day, Sir E. J. Reed, the late Sir William Pearce, Sir Nathaniel Barnaby, and Mr. William John, all certify to there being no danger to the ship nor cargo during transportation from sea to sea.

## No strain equal to the waves of the sea.

Mr. Bindon B. Stoney, the authority on "strains," says, "A ship resembles a tubular structure, more or less rectangular in section, underneath which the points of support are continually moving, so that when the waves are high and far apart the deck and bottom of the vessel are alternately extended and compressed, in the same way that the flanges of a continuous girder are, near the points of inflection, when traversed by a passing train." No such strain as this is possible on the Ship Railway.

There is reason to believe, therefore, that the ship Railway, when completed, will be an undoubted success in every way, and become the pioneer of many works of like character.

In conclusion, the author would allude to the assiduous care and attention bestowed on this work by his colleagues, Sir John Fowler and Sir Benjamin Baker, the engineers who designed and carried to a successful completion the equally novel enterprise of the Forth Bridge. Without their powerful aid and co-operation the work could hardly have reached its present advanced state of progress. Should it be the success we anticipate, Mr. Meiggs also, who undertook to raise the capital in England, as well as to contract for the execution of all the works, will be entitled to a principal share of the credit which should attach to the inauguration of a new and economic system of transportation for the benefit alike of Canada and the whole world.